Multiple Label Autoradiography Using Emitting Radionuclide

III. 22 Multiple Label Autoradiography Using Positron Emitting Radionuclide

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Autoradiographic technique that measure cerebral blood flow, glucose utilization and protein synthesis has proved useful as means to define regional patterns of these functions and been used in many studies. Recently developed multiple label autoradiographic techniques[3-5] have enabled us to measure multiple physiological changes simultaneously in the same animal. These previously developed multiple label autoradiographic techniques are very unique and useful, however, there still have been several disavantages. The purpose of this study is to establish a new multiple label autoradiographic technique using a positron emitting radionuclide tracer ^{18}F and a ^{14}C tracer respectively, and also to investigate the usefulness of ^{18}F-fluorodeoxyglucose(^{18}FDG)[1] as a glucose metabolism indicator autoradiographically.

Method

^{18}FDG 1-2 mCi and ^{14}C-deoxyglucose(DG) (80 μCi/Kg) were injected to the awaked Wistar rats. According to the method of Sokoloff et al.[6], animals were decapitated forty-five minutes later and the frozen brains were cut 20 μm thickness in a cryostat. The sections were then exposed to the KODAK NMC-1 film twice: for the first six hours to obtain the image of ^{18}F and seven days later the second exposure was done for 10 days to get the image of ^{14}C (Fig. 1).

Result

Two autoradiographic images were looked identical and the resolution of ^{18}FDG image was satisfactory (Fig. 2). Also in this precedure the influence of ^{14}C to the first ^{18}F image was thought to be lower than 2.5 %, and that of ^{18}F to the second ^{14}C image was none theoretically because at this point almost all the radioactivity of ^{18}F was decayed.

Discussion

The multiple label autoradiographic technique to obtain the multiple physiological informations from the same brain section has already been used in the pathophysiological investigation[2] and is expected to be used more widely in the future. But the radionuclides used in the previous multiple label autoradiographic techniques have several disadvantages. Miles et al. reported the method using ^{131}I and ^{14}C[5], and Lear et al. reported ^{123}I and ^{14}C technique[3], however, ^{131}I and ^{123}I have relatively long half lives of 8.06 days and 13 hr respectively and also the latter has contamination of ^{124}I (T 1/2 = 4 days) and ^{125}I (T 1/2

= 60 days), which make the image separation process long to avoid the cross contamination between the two images.

As compared to these previous techniques, our method using cyclotron produced positron emitting radionuclide ^{18}F having a very short half life of 110 minutes made it possible to get the better image separation within much shorter time. Although in our experimental procedure we waited for seven days until the second exposure, this period can be shortened down to 24 hours actually. Even at this point the radioactivity of ^{18}F has elapsed below 0.05 % of that in the beginning and the influence of this residual ^{18}F radioactivity to the second ^{14}C image is negligible. Thus our procedure could make the image separation process much shorter and also the cross image contamination was thought to be less than the previous techniques.

It is of surprise that ^{18}FDG autoradiography had satisfactory resolution nevertheless its much higher energy than ^{14}C. It indicates that ^{18}FDG can be used in various autoradiographic investigations. Also this would be the first report to compare the ^{18}FDG to ^{14}CDG to evaluate its usefulness as a glucose metabolism indicator autoradiographically. Even though ^{18}FDG has a different atom of F instead of C, the identical image as shown in Fig. 2 suggest that ^{18}FDG behaves as same as ^{14}CDG which has been a already established glucose metabolism indicator autoradiographically.

Our results indicates that the multiple label autoradiographic technique using positron emitting radionuclide ^{18}F and other ^{14}C tracers is a useful technique and ^{18}FDG can be used as a glucose metabolism indicator autoradiographically.

Acknowledgment

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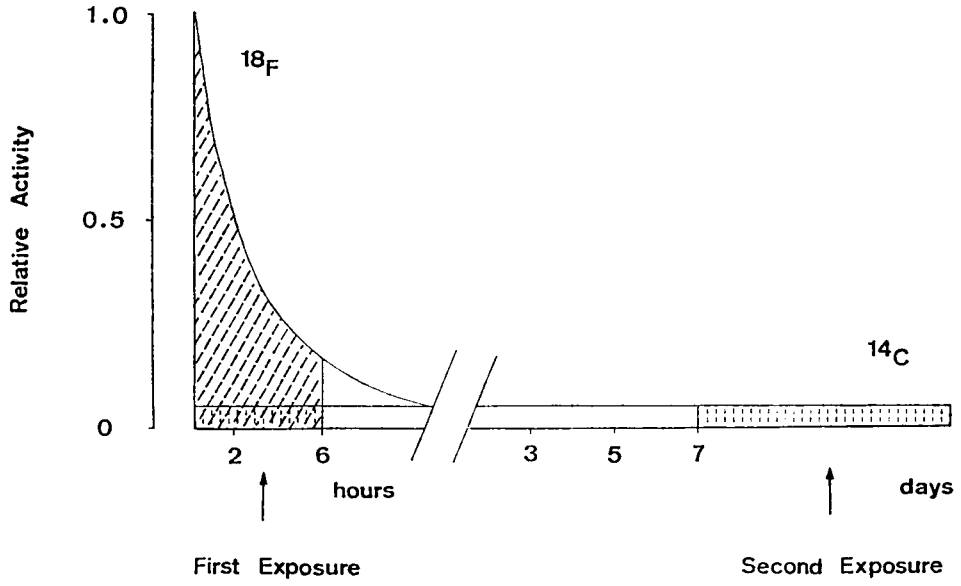

Fig. 1. Autoradiographic Differentiation between ^{18}F and ^{14}C. Tissue sections were exposed twice; during the first exposure the image comes predominantly from ^{18}F, and during the second exposure it comes entirely from ^{14}C.

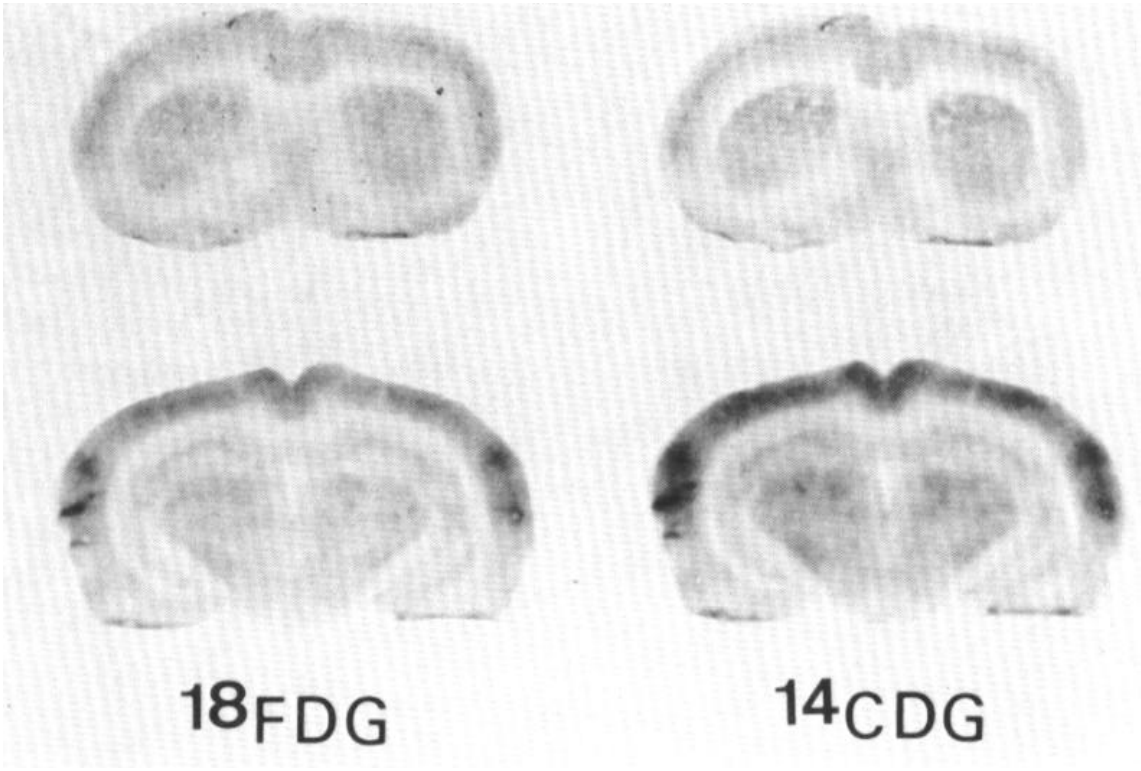

Fig. 2. Multiple label autoradiographic images of ^{18}FDG and ^{14}CDG.